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THE

PSYCHOLOGICAL BULLETIN

THE CONDITIONS OF EFFECTIVE HUMAN ACTION[1]

BY RAYMOND DODGE

Wesleyan University

I. *The Difference Between a Person and a Thing.*—If an officer should be foolish enough to command a log of wood to charge the enemy, the effect of his command would be to set up microscopic vibrations inside the log. These vibrations would die out in an infinitesimal quantity of heat that would finally radiate into space and be lost. This is a typical physical reaction. If that log had an active mind in it, with the capacity to receive impressions and to express itself in motion, a new kind of reaction would appear. The same command instead of arousing only infinitesimal vibrations will act as stimulus for a complex set of vigorous acts. Moreover, the man will act as we say intelligently. He will use complicated weapons, protect himself by available cover and coöperate with the rest of the group assigned to the same duty. In a word he will show personal initiative, skill and the capacity for training, and the ability to plan. These are characteristics of human beings. But not all human acts show initiative, skill and plan. On the contrary relatively few are on this high level.

II. *The Difference Between Reflex Action, Habit and Will.*—Choking, coughing, sneezing, cringing from pain, trembling and the like are almost as mechanical as the detonation of a cartridge when the trigger is pulled. We call them reflexes. Reflexes correspond to the simplest and most primitive organization of the nervous system. They are not mental acts at all and are very imperfectly under the control of the will. On this account they are sometimes very annoying, when one would be perfectly quiet.

Closely connected with the reflexes but vastly more important

[1] Outlines of the Study of Human Action for the Students' Army Training Corps' Section 1.

in their influence on life history are the instincts. Fear of terrifying objects, dislike at being held, satisfaction in human company, mating, solicitude of parent for child, are characteristic human instincts. They are inborn tendencies to reaction rather than specific reflexes. Quite independent of reason they furnish a fundamental basis for likes and dislikes. They are the great primitive drives in our lives. While they are capable of being modified by training and experience, they are practically impossible to eradicate. The neural mechanism of instincts resembles that of the reflexes but it is more complex in central organization. Interacting with each other and with experience instinctive reactions are frequently quite unpredictable. But no human action is free from instinctive bias.

Another kind of human act appears mechanical but is really under control of the will. Such for example are walking, eating, writing, going to sleep, and the responses of trained soldiers to familiar commands. We call them habits.

Most of the details of life are taken care of by habits. They save time. There would be very little progress if every repetition of a routine act in dressing, walking, reading, writing, etc., had to be planned as carefully as its first occurrence. It takes all the time we can spare to plan satisfactory responses to new conditions that are constantly arising. Fortunately, habit takes care of the routine. This makes it the most important factor in training. It will be discussed in Section III.

But if a veteran of the Spanish American War tried to use in the present war the habits he formed then he would be useless to himself and everyone else. Changing conditions in war, in business, in education, in all phases of life demand new plans. Old habits will not always work. When a man cannot adopt new methods to meet new situations, he is "in a rut," "an old fogie," etc.

Actions that are adapted to the circumstances, planned and guided according to the ends one wishes to accomplish, we call voluntary. The capacity to act in this way we call will.

Planning is peculiarly a human process and the condition of all human achievement.

The building of a bridge to carry a specific weight, the organization of a business enterprise, the mobilization of a nation's resources to meet a national crisis are examples.

III. *The Characteristic of Effective Action.*—The reflex sneeze or cough that relieves the mucous tickle is effective if that is all that the situation demands; but it would be a disastrous reaction

if the occasion demanded absolute quiet. Planned or voluntary action like a military operation is effective when it produces the results for which it was planned. If it fails in that no matter how brilliant or pleasing it may be it is futile. The past of most of us has many examples of effective as well as of futile and even disastrous action. Sometimes we planned well. Sometimes the difficulties were too great for our capacities. Sometimes we did not care until too late. We often made mistakes.

IV. *Reaction Time.*—In every group of raw recruits there are some whose reactions are noticeably slower than the rest. They lag behind. Some on the other hand tend to get ahead of the rest. The time it takes a person to start doing what he is told to do we call his reaction time or his latent time. It is one of the functions of military training to weld individuals and groups of men into units that act together. Perfect drill is not the useless military ornament that it often seems to the civilian. It is a sign that the body of men has become unified, trained to dependable military reactions as a body, under the controlling mind of its commander. The reaction time must be equalized and reduced to a minimum. It cannot be eliminated. No response to command can be instantaneous.

The cause of this reaction time is found in the structure of the nervous system. A command must be loud enough so that the sound waves in the air set up sound waves in the bones of the middle ear, and through them in the fluids of the inner ear. There they must excite the sensitive nerve endings that are tuned to that particular sound. Each nerve end reacts according to its own nature and passes its excitement along to other parts of the nervous system, until it finally reaches the muscles and excites them to contraction.

All these processes take more or less time. In the reflexes the number of successive processes is small, the organization is simple, and the latent time may be less than a twentieth of a second. The thing is done before we have time to think.

In habitual reactions, the nerve paths are longer. The number of successive processes is greater and the latent time cannot be reduced under one tenth of a second. This seems short enough but it becomes quite important in fencing, boxing, aiming at a rapidly moving target, etc. The latent time of planned action is always much longer. From the time a question is asked until a student thinks of the answer may range from a few seconds to infinity.

V. *The Personal Equation.*—Sometimes nerve excitement spreads out over the entire body as in trembling. Sometimes it concentrates on a single group of muscles as in moving the eyes to look at an interesting object. Sometimes it produces all the force we are capable of. Sometimes it changes the position of a limb by a hair as in the aim of a sharpshooter. The nice coördination and mutual adjustment of the different muscles of the body for each task that must be performed is the product of training. Muscle groups must be trained to coördinated action just like groups of men. The commander of the body is the brain.

When a spoken command finally reaches the brain through the nerves, it first arouses enough memory of the past to be understood. We must know what the order means. Then the organization of the response begins. How effective the response will be depends on the previous training of the brain that is in command. The raw recruit is utterly useless in battle. The better his training, the wider his practical experience becomes, the more perfectly will the muscles of his body be combined by the brain into smoothly working mutually coördinated responses. It takes months of training to make a first class soldier.

If we knew all the various factors that determine a man's reactions, his understanding, his experiences, and his capacity to coördinate his powers to the accomplishment of the task in hand, together with the rapidity of the whole reaction, we would have a kind of formula which we might call his personal equation. A rough approximation of such a personal equation is present wherever we make an estimate of a person's ability to perform a given task or to fill a position of responsibility.

Knowledge of men means that one's estimate of the personal equation of those with whom he has to do is sufficient for the purposes at hand. Efficient leadership is impossible if gross mistakes are made. It is the aims of Section II to give some practical ways of learning those factors of the personal equation that are essential to military success. Every man's personal equation must be carefully studied to place him where he can do his best for the service.

VI. *Personal Initiative.*—Military organization demands that men act together coördinately, like the muscles of the body, under the orders of the supreme command. Just as too much individual initiative in any one finger would be disastrous to good writing, or too much initiative in one eye would spoil good vision, so too much individual initiative in the men of an army would be disas-

trous. An example of this is seen in the results of the principle of 'self-determination" as practiced by the Russian armies after the Revolution.

As a rule young Americans are strong in initiative. They seem to have a natural inclination for the principle of self-determination, and a natural aversion to discipline. This makes drill all the more important in army training. But while too much initiative is a source of danger to an army when it prevents perfectly coördinated action of privates, in positions of command it becomes of the utmost importance. It is absolutely essential to a leader.

The tendency of the American private to act for and plan for himself is not always disadvantageous. It becomes a military asset when he must act alone or in small detached groups. Americans separated from their unit commands find it particularly easy to recombine. Sometimes a private with initiative will unite a group of others and render important service under circumstances where German troops because of their dependence on the commands of their regular officers would be helpless.

Initiative is absolutely essential in scouting, reconnaissance, and all intelligence service as well as in planning by officers. But not all initiative is adequate. It may miss the object as badly as old habits. To rise to the occasion when a man suddenly faces a new and difficult situation requires more than just doing something quickly. Effective voluntary action means doing just the right thing.

VII. *Practical Intelligence.*—When a mechanic can find the trouble in a stalled automobile and make it go as it should, it is proof of his practical intelligence concerning automobiles. He wouldn't need to know very much about one to wreck it. The ability to plan one's acts to meet new situations successfully is the practical value of mind, the main cause of its evolution. In the competition of practical life with its constantly changing combinations of circumstances, a person cannot win unless he is able to meet new situations as they arise promptly and effectively. This is none the less obvious in business than in war.

It is then of importance for one to study the conditions of effective will if he would make a success of any task he undertakes.

VIII. *Estimating the Situation.*—A good mechanic's first step in repairing an automobile is to locate the trouble. In every event of life from answering a question in an examination to making choice of a profession; from handling a refractory recruit to planning

a military campaign, the first condition of meeting a new situation effectively is to understand it.

The need for complete information in order to plan successful action is the reason for various important parts of the military organization. A commander must have the completest possible knowledge of the strength of the enemy, the kind and disposition of his troops, the nature of his defences, his morale, his intentions, as well as the character of the surrounding and intervening terrain. He must also know every detail of the condition of his command.

Spies, reconnaissance, observation and intelligence service are the commander's eyes and ears. No modern campaign is possible without perfect topographical maps. No detail that can hinder or help any enterprise is too insignificant. Adequate diagnosis is always the first step in treatment.

The converse of the rule also holds true. When the Germans started the war for the domination of the world they took the greatest pains to hide their motives, so that the rest of the world would fail to understand the situation that faced them. They use peace propaganda in the same way. This is the principle of camouflage; it is of fundamental importance in strategy. It is the reason why orders are kept secret, why true Americans are under sacred obligations to maintain absolute silence with respect to every scrap of military information that they are obliged to know.

IX. *Difficulties in Estimating a Situation.*—The difficulties in finding the trouble in an automobile are apparent enough to the inexpert. They would be increased enormously if the automobile had personal initiative and could plan to deceive us.

We can specify certain typical difficulties in estimating the trouble with an automobile. (1) The absence of gasoline or some other essential factor might be overlooked. (2) A short circuit might be hard to locate even if we knew it existed. (3) We might misinterpret the facts and blame the car when it was our fault after all. (4) Somebody might have planned to deceive us.

Similar difficulties are found in estimating a military situation. The intelligence service must be so organized that no essential fact is overlooked. That is why Germany filled America and the neutral countries with spies and secret agents. When darkness or smoke clouds or natural barriers hide the movements of troops, means must be found for discovering them by search lights, sound detectors and aeroplanes. When the enemy tries to mislead us as to his intentions we must learn to check up different sources of information.

Reasoning from the available reports to the intentions of the enemy is the most difficult process of all.

But all these difficulties can be overcome more or less by training the eyes, ears and minds of responsible persons. That is one of the great tasks of military education. The principles that underly it will be studied in the last section of this course.

X. *Clear Intentions.*—After the auto mechanic locates the trouble, he must form a clear idea of what he wants to do. This is the second great condition of successfully meeting a situation. Our mechanic might conceivably have any one of several aims. Instead of trying to serve this customer quickly and conscientiously, he might wish to make a big job out of a trivial one, or he might want to delay the car for police inspection, or he might be in a hurry to get to a more profitable piece of work. His main aim will determine his plan of action.

Similarly a case of insubordination must be handled quite differently when it is necessary to make an example than it would be if the aim were to reform the culprit. An attack for the sake of feeling out the enemy will be different from a blow to annihilate part of his line. In all cases after we know the situation we must have a clear idea of what we wish to accomplish before we make our plans. This idea is technically called the "mission." Of course, it is the business of the commander to determine the mission of an attack. But every subordinate must know just what his part of the mission is. This is the reason why orders must be sufficiently unambiguous, and definite so that the mission is fully understood.

Once determined, the mission must dominate the action, and be kept clearly in mind at every stage. While being executed, orders demand the undivided attention of the person to whom they are issued. Only when they are followed absolutely can a commander know what to depend on. For a charge to overrun its planned objectives may demoralize the whole plan of attack. It is the part of a good soldier to stop where he is told to stop as well as to go where he is told to go. But a mechanic cannot do every part of the job at once. In order to reach the trouble he may have to make a new tool, take down the engine, etc. But if he is a good mechanic, he would not take down the engine unless it was essential to his main aim in the job. Inclusive aims we call dominant. The lesser aims that are necessary to accomplish the dominant aim we call immediate or subordinate.

The more inclusive aims in men's lives we call ideals. They determine the person's conduct in endless ramifications and are most important factors in the personal equation. Dominant aims like patriotism, hope of promotion, success, family honor, the good opinion of friends, fear of ridicule, etc., may coöperate or antagonize each other. Obviously, it is much more important and economical to develop the dominant ideas of a group of men than it is to try to control every individual act by itself. The spirit of a company, a school, the morale of a community, an army or a nation is of the greatest consequence to those in positions of responsibility. To build up a fine morale in his command is one of the great tasks of an officer. To indoctrinate his subordinates with his main principles of action is one of the tasks of a great leader. It is the business of propaganda of all sorts to educate or emphasize those dominant ideas that are essential to the success of a task. Offensive propaganda aims to break down the morale of the enemy by encouraging them to believe they are bound to be beaten, that their officers betray them or other ideas that are antagonistic to successful warfare. Defensive propaganda on the contrary aims to develop dominant ideas of responsibility, patriotism, loyalty and the like that tend to successful warfare. Propaganda may be direct or indirect. The direct kind is often the less effective; one sees through it and resists it.

The Germans have studied this matter for years and are past masters not only in direct but in indirect propaganda of the most insidious kind. Every act that tends to break down the morale of our civil population or our soldiers is essentially an act of treason. It may be reasonably suspected of originating with the enemy. The principles that underly morale will be studied in section IV.

XI. *Effect of Dominant Aims on Subordinate Ones.*—If it becomes necessary to take down the engine to repair it, the act of taking it apart is not vandalism. It becomes just as much worth while as the main aim that it subserves. If retreat is the best way to conserve resources for final victory, then a good retreat becomes the immediate goal of action. In view of the idea of future victory, retreat is not disgraceful but glorified. In this way many things that are undesirable in themselves become of real value in the light of the ends they serve. The supreme case of this sort is the sacrifice of life itself for a great cause. But every act in life gets its value as good or bad largely from its relation to some comprehensive plan of life. In the case of an individual, an innocent bit of fun may be

treason if it incapacitates him for his duty. On the other hand, an utterly trivial thing may be invaluable if it takes its place as a necessary condition of some important move. So a wretched night in the trenches may be one of the absolutely essential factors in the plans for victory. Viewed abstractly, war is a dreadful thing and peace highly desirable. If waged for gross material gains or at the demand of junker barons war is utterly inexcusable; but when waged to prevent the enslavement of those we hold dear so that we may hand down our heritage of freedom to our children, it becomes a most sacred duty. Peace under such circumstances would be treason to ourselves and our posterity.

XII. *Mobilization of Resources.*—The third step in successful action is the mobilization of available resources. Just as a country in time of war must know exactly what it can count on in materials, machinery and personnel, just as a commander under attack must know the forces that are available to meet it, so an individual must mobilize all his skill and experience that may have bearing on any important situation that he has to face. What are a man's resources? Some of them are physical and material like health, endurance, money; some are mental like experience, knowledge and skill. Some are social like friends and followers. It is the business of every man as well as every nation to increase his resources to the utmost and to know approximately what they amount to and where they need development. To think he is wiser, or better, or stronger, or more popular than he really is we call conceit. When a conceited man overrates his own strength, he really underestimates the relative strength of the resources of his rival. That leads to foolhardy action and invites disaster.

But timidity is as disastrous as conceit. If one needs more strength and it is essential to one's life work, then he should go to the gymnasium. If it is knowledge he needs or more skill in using his mind or his hands, then he should apply himself to learning. That is what schools are for. It is the business of one who would be an officer to develop those personal resources that are essential to an officer's duties. All resources that are essential to one's life work should be cultivated.

XIII. *Selection of Appropriate Resources.*—Not every thing that the mechanic can bring to bear in taking down an engine is expedient. He must be careful not to damage the parts he removes.

Not all our personal resources are equally valuable for every situation. Physical strength and money are invaluable in their

place, but they lead to disaster if used on an officer of the law. Rhetoric is all right in its place, but if used on most Americans it will only lead to derision. The nice selection of just the right thing to do and say is called tact in social life, but the same sense of fitness and propriety, of justice and truth is important in writing dispatches or in making speeches, in business enterprises or in dealing with one's sub-ordinates, in the classroom, in planning a great military offensive, in short in every voluntary act of practical life.

XIV. *Energetic Action.*—The final step in effective action is to carry out the selected plan with promptness, energy and persistence. Without this final step, no matter how large one's resources or how excellent one's plans, he remains a futile visionary. Without adequate resources an individual or a nation is helpless,—the prey of every designer, the sport of chance. Without tact, the individual is a blunderer, "a bull in a china-shop"; his acts only "gum up the machinery." Without knowledge of the situation a man acts like a fool.

There are five main steps in effectively meeting each new situation. If one has time and the occasion is important each step should be separate and complete. Especially in training oneself to meet new situations there should be no shortcuts. The student will do well to specifically ask himself; Have I correctly estimated this situation? What is my mission? What are my resources? What is the best thing to do in the circumstances? Am I putting my best energy into the task? Later on when training is completer each step will come naturally. Sometimes the whole process will be almost instantaneous. But the lightning-like reactions of a trained mind are not careless or superficial. They are quick because training eliminates waste motions. To be effective no one of the five main steps may be neglected.

XV. *Application.*—The principles of effective action that we have been considering apply to many more cases than we have enumerated in illustration. If you are studying this course to get the most you can out of it then don't merely learn them but practice them.

Take the case of the German spy system and analyze it; understand its significance, how far it was successful, how it failed. Analyze the task of a life insurance salesman step by step and see what the principles you have studied lead him to do. Consider several concrete military facts like inspection, the S.A.T.C., the

anti-submarine warfare and study the application of each of the principles you have learned. Then recall in detail situations to which you have failed to rise, and analyze out the reasons.

Answer the following questions in terms of the principles.

Why is a paralyzed man clumsy?

Why is Holland neutral?

What is the use of a college education for officers?

What is the purpose of the military salute?

Finally apply the principles to the job you are now doing. Get the habit. You will suddenly find yourself rising to occasions that yesterday seemed far beyond you.

INDIVIDUAL DIFFERENCES[1]

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If we could adequately describe each of a million human beings, —if, for each one, we could prophesy just what his response would be to every possible situation of life,—the million men would be found to differ widely. Probably no two out of the million would be so alike in mental nature as to be indistinguishable by one who knew their entire natures. Each has an individuality which marks him off from other men. Each has not only a mind, the mind of the human species, but also his own, specialized, particular, readily distinguishable mind. Even in bodily nature, indeed, men differ so much that it would be hard to find, amongst a million, two whose features are just alike, who are equally susceptible to every disease, who have identical bodily habits. The differences in intellect and character are far greater.

We may study a human being in respect to his common humanity, or in respect to his individuality. In other words, we may study the features of intellect and character which are common to all men, or we may study the differences in intellect and character which distinguish individual men.

The study of the facts and laws applicable to all men by virtue of their common humanity gives us fundamental rules for the control of changes in intellect and character. The study of the facts and laws of individual differences enables us to apply these principles economically in the case of each individual whom we seek to influence.

In studying individual differences, it is customary to reduce the infinitude of tendencies to think and feel and act in certain ways in response to the varied situations which life offers, to the more general, and so fewer, tendencies which the psychologist calls abilities, interests, habits, qualities of mind, or mental traits.

[1] Outlines of the Study of Human Action for the Students' Army Training Corps, Section 2.

This chapter is part of *Individuality*, published by the Houghton Mifflin Co., of Boston, who have permitted its republication here as part of the work for the S. A. T. C.

Thus the hundreds of connections between the situations represented by all the possible problems in addition and the responses represented by all their solutions, are reduced to the one trait, "ability to add." Thus the many inborn connections between, on the one hand, seeing and touching blocks, sand, strings, wire, stones, water and other material objects, and on the other hand examining, poking, pulling, putting together, taking apart, forming and reforming those objects, are comprised in the one trait, "the instinct of constructiveness" or "the interest in manipulation."

Individual Differences in Single Traits.—It is useless to recount the traits in which men have been found to differ. For there is no trait in which they do not differ. Of course if the scale by which individuals are measured is very coarsely divided, their differences may be hidden. If, for example, ability to learn is measured on a scale with only two divisions, (1) "ability to learn less than the average kitten can" and (2) "ability to learn more than the average kitten can," all men may be put in class two, just as if their heights were measured on a scale of one yard, two yards, or three yards, nearly all men would alike be called two yards high. But whenever the scale of measurement is made fine enough, differences at once appear.

The differences exist at birth and commonly increase with progress toward maturity. Individuality is already clearly manifest in children of school age. The same situation evokes widely differing responses; the same task is done at differing speeds and with different degrees of success; the same treatment produces differing results.

There can be little doubt that of a thousand ten-year-olds taken at random, some will be four times as energetic, industrious, quick, courageous, or honest as others, or will possess four times as much refinement, knowledge of arithmetic, power of self-control, sympathy, or the like. It has been found that amongst children of the same age and, in essential respects, of the same home training and school advantages, some do in the same time six times as much, or do the same amount with only one tenth as many errors.

The ways in which and to the extent to which individuals differ in mental traits can be best understood by considering the *Distribution* of the trait, that is, the number of individuals possessing each degree of it. For example, the distribution of stature in American boys ten and a half years old is roughly as follows:

Out of 1,000 boys, there are:

Between	109	and	113	centimeters	tall,	2	boys,
"	113	"	117	"	"	5	"
"	117	"	121	"	"	25	"
"	121	"	125	"	"	97	"
"	125	"	129	"	"	199	"
"	129	"	133	"	"	255	"
"	133	"	137	"	"	228	"
"	137	"	141	"	"	126	"
"	141	"	145	"	"	49	"
"	145	"	149	"	"	11	"
"	149	"	153	"	"	4	"

The facts of this table become clearer to the eye if, instead of the numbers 2, 5, 25, 97, etc., we draw 1000 little lines as in Figure 1, letting each line stand for one boy.

FIG. 1. Showing the distribution of stature in 1,000 American boys. Each individual represented by a line.

It is customary to represent the amounts of the trait not by a verbal statement like "from 109 cm. to 113 cm.," but by a distance along a scale from the point on the scale marked 109 cm. to the point marked 113 cm.; and to represent the number of individuals who possess that degree of the trait not by the number of lines, but by the size of an area. The previous table then becomes Fig. 2.

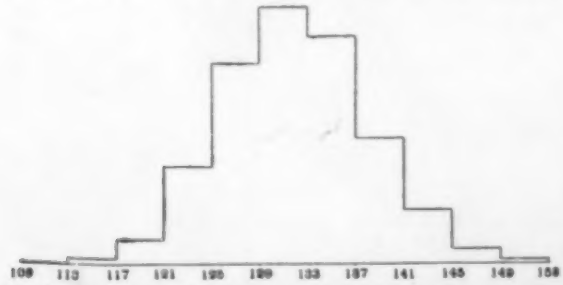

FIG. 2. Showing the distribution of stature in 1,000 American boys. The areas represent the number of each height.

Such a figure is called the *Surface of Distribution* of the trait. Such distribution tables or surfaces are, so to speak, the language of individual psychology. They tell us what the "type" or "norm" or common tendency is, how and how far individuals vary from the type, whether there are secondary or sub-types, how "abnormal" any given degree of the trait is, and the like. For instance, in the case of our illustration, it is clear that there is one central tendency, the typical height for a boy of this age being about 133 cm.; that slight individual variations from the type are very numerous, but that large variations from it are very rare; that the variations are continuous, individuals being found of every height from 110 cm. to over 150 cm.; that a boy over 149 cm. tall at the age of ten and a half would be abnormal in the sense that he would occur only once in two hundred and fifty times, but would not be abnormal in the sense of being removed from ordinary children by a distinct gap.

All thought about individual differences in single traits should be carried on in terms of such distribution tables or surfaces, each derived from the actual measurement of a large representative group of individuals. It is misleading to form opinions from casual observations of human nature without accurate measurements. For casual observation is struck by extreme, odd, exciting, and desired facts. It notes, for example, that two railroad wrecks occurred at the same day and hour, that it has not rained for two months, that Walter Scott was thought dull as a boy, that the rule of the Republican party has greatly increased (or decreased) prosperity. It is misleading to judge from measurements of a few individuals. For their meaning can be rightly seen only by comparison with the total distribution in respect to the trait in question. In theory and in practice, we must think of an individual in any one trait not only as he is in and of himself, but as he is in relation to all men,—as one variation amongst others in the total distribution in respect to that trait. There is indeed no one habit of thought about human nature more important for the understanding of individuality than the habit of thinking of the different amounts or degrees of each single quality or trait as distances along a scale, and of men and women as distributed along that scale each at his proper point.

The study of such distrbutions in the case of qualities of intellect and character, has brought to light two facts, both at variance with common opinion and both of importance for the practical treatment of individuals. First, *the variations in any single trait are usually*

continuous. Second, *the variations usually cluster around one and only one type.*

The continuity of variations appears in every trait that has so far been measured. Men rarely or never fall into distinct classes with gaps between,—bright, average, and dull, sane and insane, visualizers and non-visualizers, courageous and cowardly, and the like. On the contrary, between the least and the greatest, the best and the worst, every degree is represented.

The clustering around one type, though not perhaps as universal as the continuity of variations, is also to be expected, save under certain conditions in the causes that produce the trait. The true state of affairs is that shown by such distributions as those of Fig. 3,

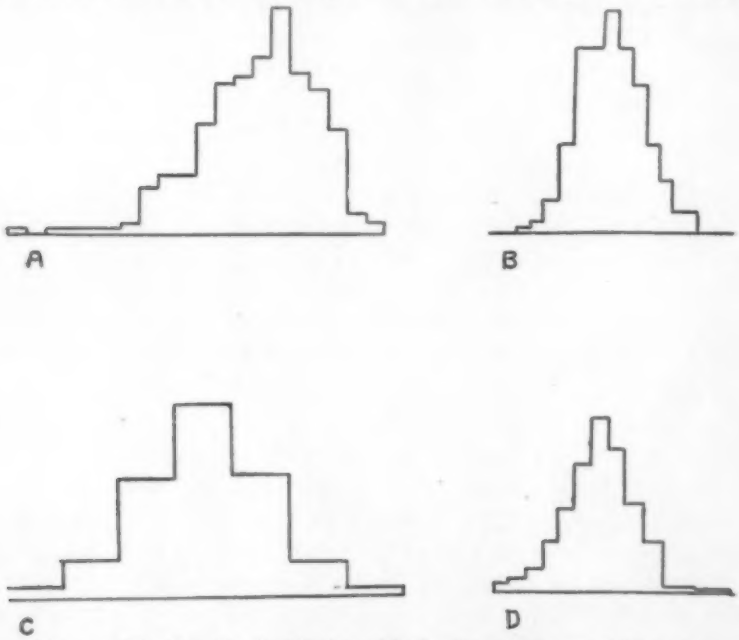

FIG. 3. Showing the distribution with the clustering around the type.

not by such as those of Fig. 4. We must not be misled, by the habit of thinking in words, into the false belief that individualities are grouped into classes to fit those words. The usages of language are rarely competent to express the real fact of variations clustering around one type or mode and, as the variation increases, occurring in ever-diminishing frequency. That we call people good or bad does not mean that there are two types or modes of character. That

the words "deficient," "normal," and "superior" are used of any trait is no proof that individuals in that trait show a separation into three groups, all in one group being much like one another and little like any of those in the other groups.

We must learn to think of the degree or amount of any quality

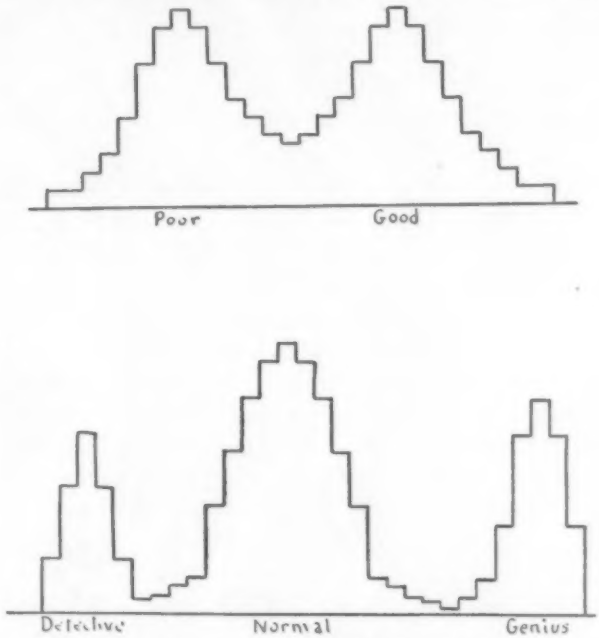

FIG. 4. Showing an anomalous distribution.

in an individual not by an adjective, but by a numerical amount. In the great majority of single traits, there is only one type or mode, so that any division into distinct classes according to the amount of the trait is arbitrary. The distribution being as in Fig. 5, it is equally possible to divide individuals into two, three, four, five,

FIG. 5. Showing a normal distribution with possibility of making smaller groups.

six, seven, eight, or eight hundred classes; and for any given number of classes one may put the dividing lines in one place as well as another. Consequently classifications of individuals with respect to the amount of any single trait are almost always useless if not misleading. The story is to be told, not by a series of names, but by a surface of distribution erected on a numerical scale.

Turning again to Fig. 3, one notes that all the distributions there shown have, as a common feature, the great frequency of mediocrity and the rareness of both specially low and specially high degrees of a trait. Approximately this is the rule for the original individualities of mankind. Approximately this remains the rule for many traits throughout the course of life and its training. In many traits a very small difference in ability or attitude near the middle point of the scale includes a great many individuals. This fact explains much in human behavior. For instance, social and political movements are often instigated by individuals who are at the extremes of the scale with respect to some doctrine. But the deciding votes are almost always cast by individuals who have no very pronounced inclination in either direction. The attractiveness of some hero, the suggestive power of some battle-cry, an affront to the sense of fair play, a year of hard times, a moderate expenditure of money, even the mere desire for novelty, may turn the balance, because only a slight addition to the attractiveness of one proposal is needed to move a great number of those near the point of neutrality. To overturn a large majority requires only a small change in opinion. A slight improvement in teaching may make a misunderstood point clear to a large percentage of the class.

The facts that have been stated concerning the distribution of single traits prove that any method of managing men which is the best possible for those of one degree of a trait cannot be the best possible for all individuals. Nor will two or three varieties of treatment suffice to influence all in the best way. Variations in human nature are wide and continuous, so that theoretically treatment also must vary much and continuously.

Individual Differences in Combinations of Traits.—The variety of human nature possible when one man is compared with others in respect to all possible traits is practically infinite. Even if man's nature included only five traits, *a*, *b*, *c*, *d*, and *e*, and even if each of these existed in only five degrees, 1, 2, 3, 4, and 5, there could be over three thousand (3,125, to be exact) varieties of men. With hundreds of traits, each represented in hundreds of degrees, the

varieties possible are practically infinite. All the principles involved can, however, be understood in a simplified case such as that of the five traits, each appearing in five degrees. In the simple case any one individual would be represented by an equation such as:

$$\text{W. Roberts} = 2a + 2b + 5c + 3d + 3e,$$
$$\text{John Smith} = 1a + 4b + 2c + 5d + 1e,$$
$$\text{H. Thomas} = 4a + 1b + 1c + 2d + 3e,$$

or, more clearly, by a series of points on the five scales for the five traits as in Fig. 6.

Over three thousand varieties are possible, but they need not

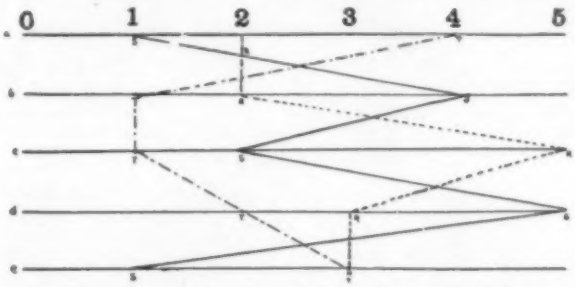

FIG. 6. The combinations of traits of three individuals.

all occur. For example, suppose that the amount of trait *a* that an individual possessed was so related with the amounts of *b*, *c*, *d*, and *e* that he possessed, that if he had 2*a* he would have also 2*b*, 2*c*, 2*d*, and 2*e*, while if he had 4*a* he must have 4*b*, 4*c*, 4*d*, and 4*e*, and similarly for 1*a*, 3*a*, and 5*a*. Then the only varieties of individuals that could exist would be:

Some who were $1a + 1b + 1c + 1d + 1e$,
" " " $2a + 2b + 2c + 2d + 2e$,

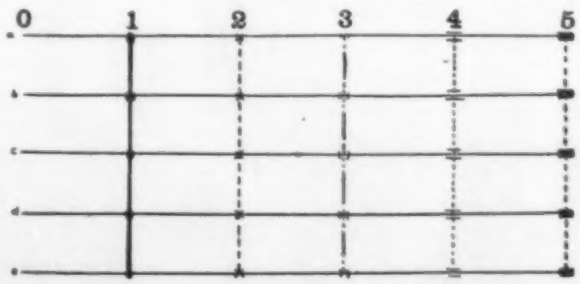

FIG. 7. Five possible types of individuals.

and so on, five varieties in all, shown in Fig. 7. Or suppose that an individual having $5a$ could never have less than 3 of b, c, d, and e. Then such individualities as—

$$5a + 2b + 4c + 3d + 5e,$$
$$5a + 5b + 1c + 4d + 3e,$$

and the like could not exist. The kind of varieties that can exist will then express the relations, or, as they are commonly called, the *correlations*, between the amounts of the five traits, that is, the extent to which the amount of one trait possessed by an individual is bound up with the amount which he possesses of some other trait. This is as true for five hundred traits as for five, and for an infinite number of degrees of each as for five degrees. *What kind of individuals there will be, and what proportion there will be of each kind, is a result of the distribution of individuals in single traits and of the correlations of the traits.* To this fact we shall soon need to return.

Confronted by the infinite variety of total human natures, thinkers have hoped to find certain types—the genius, the insane, the criminal, the defective, the artist, the man of affairs, and the like,—such that all, or at least many, individuals would belong under one or another of these types. A type represents some particular combination of amounts of the list of human traits. For example, suppose the list of traits to be a, b, c, d, and e, and the degrees of each to range from 0 to 10. The combinations

$$\text{(I)} \quad 2a + 5b + 5c + 8d + 10e,$$
$$\text{(II)} \quad 10a + 2b + 2c + 1d + 0e,$$
$$\text{and (III)} \quad 4a + 4b + 4c + 6d + 5e,$$

would be possible types. They are represented graphically in Figure 8.

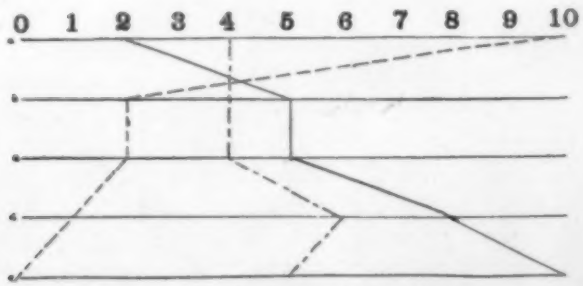

FIG. 8. Three types of individuals.

Now such individuals as:

$$(1)\ 1a + 4b + 5c + 9d + 9e,$$
$$\text{or } (2)\ 3a + 4b + 5c + 8d + 10e,$$
$$\text{or } (3)\ 2a + 5b + 6c + 8d + 10e,$$

obviously vary little from Type I, but much from Type II or Type III.

Such individuals as:

$$(4)\ 10a + 1b + 2c + 0d + 2e,$$
$$(5)\ 9a + 2b + 2c + 2d + 1e,$$

vary little from Type II, but much from Type I or III. Consider similarily such individuals as:

$$(6)\ 4a + 5b + 4c + 6d + 3e,$$
$$(7)\ 2a + 4b + 4c + 5d + 4e,$$

These facts are easily seen in Figure 9, which represents Types I, II, and III and individuals 1 to 7.

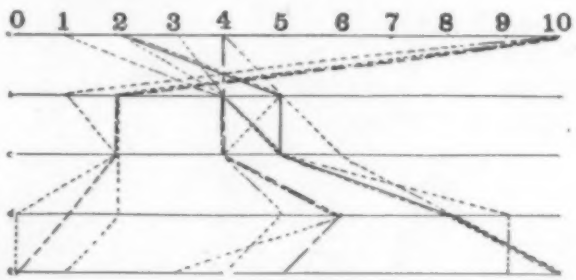

FIG. 9. Representing seven individuals of types I, II, and III.

The customary view has been that "types" or particular combinations of amounts of human traits, could be found so that any individual would be much like some type and much less like any of the others. But no one has succeeded in finding such types, and the more clearly the supposed types are defined, the surer it becomes that intermediate conditions, equally like several of the types, exist in great numbers. Either new types have to be added until there are so many that one may as well let each individual be his own type; or the number of individuals not falling readily under any type is so large that the attempt to classify men by them hinders

rather than helps thought and practical control. Only very rarely can anything approaching at all closely to an accurate and adequate account of a man's individuality be given by the statement that he is of this or that "type."

In fact, there is much reason to believe that human individualities do not represent ten or a hundred or a thousand types, but either *one single type* or *as many types as there are individuals*, according to whether the thinker wishes to emphasize the common humanity around which they vary or the exact nature of their variations from it. By this view the effort to assign individuals to a number of classes, as we assign animals to the classes "mammals," "reptiles," "amphibians," "fishes," etc., is doomed to failure or incompetence. The first duty of the thinker is to learn the constitution of the one type, *man*. His second duty is to learn each individual's variation from this common humanity. In theory it means that man is mentally, as much as physically, one species. In practice it means that each individual must be considered by himself.

It certainly is the case that almost all of the detailed classifications of individuals in accord with the multiple-type theory are either useless or misleading. The commonest element in such classifications is the supposed principle of compensation or balance, whereby, for example, a "quick but careless" type is constrasted with "slow but sure" type; or an "easy learning, quickly forgetting" type is contrasted with the slow learner who retains long; or efficiency in thought, efficiency in action, and delicacy in sentiment are supposed to be exclusive, each of the other two. Such types, presupposing relations of compensation between intrinsically desirable traits, are almost certainly illusory.

All trustworthy studies so far made of the relations between the amounts of desirable single traits in the same individual agree in finding direct or "positive" relations between such traits. Having a large measure of one good quality *increases* the probability that one will have more than the average of any other good quality. He who can learn better than the average through the eyes, tends to learn better than the average through the ears also; he who can attend to one thing better than all other men, will be able to attend to many things at once or in rapid succession better than most of them. Artistic ability, as in music, painting, or literary creation, goes *with* scientific ability and matter-of-fact wisdom. The best abstract thinker will be above the average in concrete thought also.

The rapid workers are the most accurate. Intellectual ability and moral worth hang together.

The correlations are, of course, not perfect. A large degree of superiority in one desirable trait may involve only a slight superiority in many others. And since the relations vary enormously amongst individuals, a person highly gifted in one respect will often, though not usually, be very inferior in others.

TESTS OF GENERAL INTELLIGENCE

BY L. M. TERMAN

Stanford University

The preceding study of individual differences has shown us how enormously men differ in mental ability, and how important these differences are in determining one's fitness for a given kind of work. Now the work to be done in the army ranges in intellectual difficulty from that which can be done by any who is able to use a pick and shovel to that which demands the highest type of insight and resourcefulness. If the army is to be efficient it is evident that the work which requires most brains must be given to men with brains. We can easily imagine what would become of an army if all the men in it who were fit to command were set to digging the trenches, and if those fit only to dig trenches were made its officers. Plainly if the army machine is to work smoothly and efficiently it is as important to fit the job to the man as to fit the ammunition to the gun.

Of a million drafted men sent to receiving stations, several thousand will have to be rejected for mental deficiency, several thousand will be mentally unable to learn the drill but will be able to do useful labor in service battalions, several thousand will be needed for officers, and the remainder will have to be trained for various tasks of intermediate difficulty. How shall we go about it to place each man as nearly as possible at his proper level, that is to say, at the place where he can render his maximum contribution to the service? By some method or other the intelligence of every soldier will have to be estimated or judged. How shall it be done?

The Method of Trying Out.—One method would be to try out each soldier in tasks of various degrees of difficulty. The method is fairly sure. It could probably be depended upon to give us an efficient army within a few years.

So with the method of natural sifting. If the war should last long enough the best men would pretty certainly in time demonstrate their ability and rise to positions of responsibility, while those of poorest mentality would gravitate to the humbler tasks. But the gravitational method of sifting meets many resistances, and like the method of trying out, is necessarily very slow.

Pseudo-scientific Methods of Rating Mentality.—A century ago a French physiologist, by the name of Gall, founded what he thought was a new science, which was named phrenology. According to phrenology, definite and constant relations were believed to exist between certain mental traits and the contour of the head. It was believed, for example, that one's endowment in such traits as intelligence, combativeness, sympathy, tenderness, honesty, religious fervor, and courage, could be judged by the prominence of various parts of the skull.

It is unnecessary to question the sincerity of Gall and his over enthusiastic followers. They were probably not guilty of conscious deception, but merely blinded by an attractive theory. At any rate, the "science" of phrenology has been hopelessly exploded. It has been well demonstrated:

1. That traits like those mentioned above do not have separate and well defined seats in the brain, and

2. That skull contour is not a reliable index of the brain development beneath.

In the underworld of pseudo-science, however, phrenology and kindred fakes still survive. Hundreds of men and women still earn their living by "feeling bumps on the head," reading character from the lines of the hand, etc., But modern warfare has no time for pseudo-science. A general would no more think of selecting his officers by phrenological methods than of substituting incantations for gun powder.

The Method of Off-hand Judgment.—But if in the rating of men pseudo-science is misleading, perhaps science is still unnecessary. It may be argued that mental traits can be rated accurately enough for all practical purposes on the basis of ordinary observation of one's behavior, speech, and appearance. We are constantly judging people by this off-hand method, because we are compelled to do so. Consequently we all acquire a certain facility in handling the method. For ordinary purposes it is infinitely better than nothing. A skillful observer can estimate roughly the height of an aëroplane; but if we would know its real height we must use the methods of science and perform a mathematical computation.

The trouble with the observational method is its lack of a universal standard of judgment. One observer may use a high, another a low standard of comparison. A four-story building in the midst of New York's "sky scrapers" looks very low; placed in the midst of a wide expanse of one-story structures it would look

very tall. The captain of a very superior company may rate his least intelligent man as "very dull"; the same man in a very inferior company would likely be rated as "average" or better.

Moreover, we are easily misled by appearances. The writer knows a young man who looks so foolish that he is often mistaken by casual acquaintances for a mental defective. In reality he is one of the half dozen brightest students in a large university. Another man who in reality has the mentality of a ten year old child, is so intelligent looking that he was able to secure employment as a city policeman.

Language is a great deceiver. The fluent talker is likely to be over-rated, the person of stumbling or monosyllabic speech to be underrated. Similar errors are made in judging the intelligence of the sprightly and the stolid, the aggressive and the timid, etc. Our tendency is also to overestimate the intellectual quality of our friends and to underestimate that of persons we do not like.

If the method of off-hand judgment were reliable, different judges would agree in their ratings of the same individual. When the judges disagree it is evident that not all can be correct. When intelligence is rated in this way wide differences of opinion invariably appear. Twenty-five members of a university class who had worked together intimately for a year were asked to rank the individuals of the class from 1 to 25 in order of intelligence. The result was surprising. Almost every member of the class was rated among the brightest by someone, and almost every member of the class among the dullest by someone. Doubtless the judges were misled by all kinds of irrevelant matters, such as personal appearances, fluency of speech, positiveness of manner, personal likes and dislikes, etc. Think how much error there would be if a company commander were rating the intelligence of 250 men newly assigned to his command.

The method of personal estimate is much better than the method of external signs (phrenology), but to be reliable it must be supplemented by a method which is *objective;* that is, a method which is not influenced by the personal bias of the judge or by such irrelevant factors as appearance, speech, or bearing of the one to be rated. Such is the method of intelligence tests.

Intelligence Tests a Method of Assaying Mentality.—A man wishes to find out the value of a gold bearing vein of quartz. How shall he set about it? One way would be to uncover all the ore and extract every ounce of gold contained in it. It is hardly necessary

to point out that this would be a slow and risky procedure, one that might easily cost a fortune and bring small returns. But granting that the extent of the quartz vein was known and that the cost of bringing it to the surface could be calculated, would this be sufficient to tell us the value of the mine? The answer is obvious; something depends on whether the quartz contains many dollars worth of gold or only a few pennies worth, per ton of ore.

However, the next step is easy. It is only necessary to take a few random samples of the ore to an assayer, who makes a simple test and returns the verdict of so many ounces of gold per ton of rock. The verdict of the assayer may justify the expenditure of a million dollars, or it may tell us the mine is not worth a penny. At any rate the question of value is answered.

Suppose the question before us is not the value of a gold bearing vein of quartz, but the intellectual quality of a human mind. If we are to rate the quality of a man's intelligence will it be necessary to make this intellect perform every act of which it is capable in order that these may be added together for a total intelligence rating? This would be one method of answering the question, but a rather tedious one, considering the innumerable acts which a human mind is able to perform. Perhaps this is not necessary. Conceivably it might be possible to sink shafts, as it were, at certain critical points, and by examining a few samples of the mind's intellectual product to estimate its intrinsic quality by a method analagous to that of the assayer.

Such is the method employed in all systems of testing intelligence. The mind is given a number of "stunts" to perform, each of which requires the exercise of intelligence. By the quality of these the quality of the entire mind is judged. The tests tells us whether the mind in question is one of rich content and rare intellectual power, or whether it is mediocre or perhaps even defective.

Collecting Samples for Assaying.—In ascertaining the value of the gold deposit would it be safe to take all the assayer's samples from a single part of the quartz vein? Common sense would of course suggest the precaution of taking samples from many places and of estimating the gold content in terms of average richness. Similarly in testing intelligence the subject is not asked to perform one intellectual "stunt," but many. He may be given tests of memory, of language comprehension, of vocabulary, of orientation in time and space, of ability to follow directions, of knowledge about familiar things, of judgment, of ability to find likeness and differ-

ences between common objects, of arithmetical reasoning, of resourcefulness and ingenuity in practical situations, of ability to detect the nonsense in absurd statements, of speed and richness of mental associations, of power to combine related ideas into a logical whole, of ability to generalize from particulars, etc. The average of a large number of performances thus gives a kind of composite picture of the subject's *general intelligence*.

Intelligence Scales.—Such a system of tests, chosen for variety and for reliability, is known as an "intelligence scale." Many intelligence scales have been devised. The first was that of the French psychologist, Binet, who was aided in his work by the French physician, Simon. As left by its authors the Binet-Simon scale included fifty-four tests, ranging from tests so easy that they can be answered by a majority of three-year-old children to tests so difficult that they tax the intelligence of an average adult.

The Binet-Simon scale has since been extended to include ninety tests and to sample a greater variety of mental functions. Once a feasible method of mental measurement was demonstrated, it was easy enough to construct other intelligence scales. Now we have many, including three which were devised specially for use in the army. Gradually the method was applied to other kinds of mental probing, so that now tests are available for various mental processes other than the intellectual.

The essential principle of all intelligence scales is the same. Always it is the method of the assayer. Typical samples of intellectual activity are collected and then subjected to analysis.

Use of Standards in the Rating of Samples.—Supposing our intelligence scale has given us sample intellectual products, how are these samples assayed; that is, interpreted? What does it signify, for example, whether a subject being tested can think of a hundred words or only forty words in three minutes? Whether he puts together the parts of a form board in thirty seconds or two minutes? Whether a series of seven digits or only a series of three can be repeated after a single hearing? Whether there are three, two, one, or no successes in the attempt to draw a diamond shaped figure from copy?

The secret lies in the standardization of the tests. Without standards for comparison the tests mean nothing. Standardization has come to play the same rôle in psychology that it has long played in other lines of applied science. Two pieces of steel may look very much alike, but standardized tests may show that one is capable of

withstanding twice as much strain as the other. Two drops of blood may be indistinguishable in appearance, but a simple physiological test may show that one has been taken from a healthy, well nourished person, the other from a person who is anemic or diseased. There are a few thing which appear more alike on casual inspection that the balls of two thumbs; yet one who has been taught the trick can find in a finger print forty or more separate characters, a single one of which will distinguish it from the finger print of any other human being.

So it is with mental tests. The "sample" product secured by an intelligence test acquires real meaning only when it is compared with samples secured from all sorts of individuals, including children of all ages, adults of all degrees of intelligence, feebleminded, insane, geniuses, etc. Just as a man may be hanged on the evidence of his finger prints, so a man may be discharged from the army for feeblemindedness on the evidence of a half dozen standardized tests of intelligence. More important still, the tests quickly identify men whose mental superiority fits them for special responsibilities.

Advantages of the Test Method.—Summarizing, the test method has four great advantages:

1. It gives us a universal standard of comparison. The result is absolutely uninfluenced by the general intellectual level of the group with which the subject to be rated happens to be associated. It is like measuring the height of a house instead of estimating it by comparison with the height of surrounding buildings.

2. It multiplies enormously the significance of a mental performance. It does this by making fine distinctions which would be overlooked by the method of off-hand judgment. It is like placing a smeared glass under a microscope and discovering that the smear is a complicated network of organic matter.

3. The test method is objective; that is, free from the influence of personal bias. It gives approximately the same verdict today, next week, or next year. It does not change its opinion. More important still, the verdict will be approximately the same whoever makes the test, whether a relative, a stranger, a friend, or an enemy, provided only the rules of procedure be rigidly followed.

4. The test result is little influenced by the subject's educational advantages. In this it differs greatly from off-hand judgment, which so easily mistakes the results of schooling for real intelligence. The test method probes beneath the veneer of education and gives an index of raw "brain power." For example, a young woman who

had been stolen in early childhood by gypsies and had spent her life with them, was given the Binet-Simon intelligence test. She had never attended school a day in her life and had only learned to read by bribing a little school girl to teach her the alphabet; yet she made a higher score than the average found for two hundred high school pupils who were given the same test.

No wonder mentality tests have acquired such a wide vogue in the ten years since Binet gave to the world the first successful intelligence scale. In that time they have demonstrated their usefulness in the study of the feeble-minded, in the grading of school children, in determining the mental responsibility of offenders, and in the selection of employees. Their largest and most useful applications has been in the mental classification of men in the United States Army.

Questions and Problems

1. Suppose you had to indicate, within a few days, the best and poorest men in a draft quota of 1,000. What methods would you rely upon if mental tests were not available?

2. What factors are likely to weigh too heavily in determining a man's reputation for intelligence?

3. Mention all the things you can think of which cause us to understimate a person's intelligence. To overestimate it.

4. It has been emphasized in this chapter that different people use different standards in judging the intelligence of a man. Does the standard used by any one person remain constant, or does it vary from time to time?

5. Is the borderline between normal intelligence and feeble-mindedness sharply defined? Look up some of the definitions of feeble-mindedness in current psychological literature and criticize them from the point of view of scientific exactness.

6. Examine the tests in the Binet-Simon Intelligence Scale and try to find the essential differences between tests of this kind and the questions which any person might ask another in order to "size him up." Wherein is the Binet type of question better?

7. Test your vocabulary on the Stanford Vocabulary Test. (Instructor will supply the list of words from the Stanford Binet Record Booklet.)

8. An experiment in the off-hand estimation of intelligence.

Problem: To find how well different persons agree in estimating the intelligence of an individual.

Method: Members of the class rate one another and compare results. The following procedure is recommended:

(*a*) Let the basis of rating be the numbers from 40 to 1. Let 40 represent the brightest university student you have ever known, 1 the dullest, and 20 the student of average intelligence. The rating 30 would be half way between the average and the brightest, and 10 half way between the average and the dullest.

(*b*) Each student is given a list containing the names of all the members of the class. He rates the intelligence of *every student whom he knows by sight and whom he has heard talk for a least a few minutes*, indicating his rating by writing a number from 1 to 40 after the name. The list, containing ratings, is then passed in, unsigned, to the instructor (or to a member of the class chosen for the purpose).

(*c*) The instructor (or specially designated student) tabulates the ratings received by each member of the class and reports the amount of agreement and disagreement, of course omitting names.

Results.—1. Is there anyone in the class who received the same rating from all his judges?

2. What is the average difference in points between a man's highest and lowest rating?

3. Do the judges agree better on some individuals than on others?

4. How reliable is the rating given a man by a single judge?

GENERAL REVIEWS AND SUMMARIES

CUTANEOUS SPACE

BY HAROLD E. BURTT

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Brown and Stewart (2) studied the errors of tactual localization of a soldier with cutaneous hypoaesthesia due to a bullet wound in the left parietal lobe. The experiments were made fourteen months after the wound was received. The affected hand was screened from the subject's view and a series of spots on the fingers stimulated by a bristle. The subject indicated on a model the spot where he felt the stimulus. Then certain spots were "trained," *i. e.*, stimulated with the subject aware of which was to be touched or actually watching the process. Trials of the original sort were frequently intermixed. With two of the trained spots there was a marked improvement in accuracy of localization,—62 and 110 per cent.,—while with the other trained spot and the untrained ones the improvement was very slight. Aesthesiometer experiments on the same individual showed a very high threshold on the affected side of the body and when the duality was recognized the points seemed very close together.

Foucault (5) investigated the tactual perception of linear extension on the finger by the application of two æsthesiometer points separated by a distance which gave the impression of a line. The subject reproduced with a pencil and paper the length of the apparent line he had perceived tactually. In some instances the stimulus was moved on the skin during the trial. The error of reproduction was found to decrease with increase of the distance between the two points. Movement made the apparent length of the lines increase. Practice did not, in general, reduce the errors.

Fitt (4) presented with two simultaneous unmoved points distances above the tactual spatial threshold. The constant method was used with a visual distance (between two dots) as normal and a tactual distance as variable. Results were obtained for the fingers, cushion of hand, back of hand, forearm and back of neck. The general law seemed to be that parts of the skin with a small spatial threshold (more mobile parts) overestimated distances, and in passing to regions with higher threshold (less mobile parts) this

overestimation decreased through the zero point to underestimation. It is suggested that originally there was general underestimation but through the course of evolution this tendency decreased much as the tactual threshold itself decreased. Plotting the percentage of over or under estimation (ordinate) against the corresponding space threshold (abscissa) for groups of different ages from six to adult, the curves all sloped downward to the right,—the general law (supra),—but the total curves for the youngest and oldest individuals were higher. That is at ages ten to twelve the judgments were all underestimations while at the age extremes there were overestimations for the regions of the skin with small thresholds. This breakdown in the touch sight coördination in childhood, it is suggested, is due to the change from the seeing and handling of infancy to the abstraction of school life, and the subsequent improvement is due to the acceleration of puberty.

Waterman (7) presented circular tactual stimuli (ends of tubes) of various sizes to the palm of the hand and the tip of the tongue. The subject in each case indicated which of a graded series of circles on a card before him was the same size as the circle felt. With the stimuli used, varying in circumference from 1.5 to 6 cm., there was an average underestimation with both hand and tongue. The underestimation with the hand was greater, 27 per cent. as contrasted with 18. The individual variations in the estimation of sizes were greater for the hand than for the tongue. The average deviations for hand and tongue showed no difference.

Burtt (3) studied the tactual illusion of movement produced on the forearm by two punctate stimuli in quick succession and a discrete distance apart. A row of brass rods actuated by solenoids gave the stimuli. The time distance and intensity factors were varied and their interrelations necessary to produce the optimal impression of movement determined. It was found that the longer the stimuli were applied the relatively shorter was the optimal interval between their applications; the greater the distance between the stimuli the greater the time interval; the greater the intensity the smaller the interval and the greater the distance the greater the intensity. If the intensity of the second stimulus was greater than that of the first the illusory movement was some times in the reverse direction. These results are similar to those of other studies of the illusion of movement in vision and audition. The existence of the illusion in all three sense departments and of the same relations between the intensity, time and distance variables

in all three cases points to a common explanation which is found in the action theory and the continuity of motor impulses involved in bringing the stimuli into the focus of attention.

In two studies comparing blind and seeing individuals in various respects there are results which bear on the topic under review. Seashore and Ling (6) found no significant difference in the two-point threshold on the forearm and finger between normal and blind children. On the finger, however, the normal group had a greater mean variation. Bond and Dearborn (1) tested boys in an institute for the blind and in a technical school with a complicated form board. The normal boys average nine months older but made three times as many errors and took nearly half again as long. The authors consider that "the higher degree of sensibility to touch and to the feelings of movement and position in the blind is demonstrated" and suggest that it is due to training.

References

1. Bond, N. J., & Dearborn, W. F. The Auditory Memory and Tactual Sensibility of the Blind. *J. of Educ. Psychol.*, 1917, **8**, 21–26.
2. Brown, T. G., & Stewart, R. M. On Disturbance of the Localization and Discrimination of Sensations in Cases of Cerebral Lesions and on the Possibility of Recovery of These Functions after a Process of Training. *Brain*, 1916, **39**, 339–454.
3. Burtt, H. E. Tactual Illusions of Movement. *J. of Exp. Psychol.*, 1917, **2**, 371–385.
4. Fitt, A. B. The Estimation of Distance by Sight and Passive Touch: Some Investigations into the Evolution of the Sense of Touch. *J. of Exp. Psychol.*, 1917, **2**, 264–288.
5. Foucault, M. La perception tactile de la forme. *Rev. Phil.*, 1916, **82**, 547–568.
6. Seashore, C. E., & Ling, T. L. The Comparative Sensitiveness of Blind and Seeing Persons. *Psychol. Monog.*, 1918, **25**, No. 108.
7. Waterman, C. N., Jr. Hand-Tongue Space Perception. *J. of Exp. Psychol.*, 1917, **2**, 289–294.

SPACE ILLUSIONS

BY HARVEY CARR

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Peterson (4) describes two cases of the autokinetic illusion exhibited by a camp fire perceived at night against a distant mountain side. The illusion disappeared when a near object was used as a sight, but it reappeared with usual conditions of observation.

Downey (3) studied the relation of intelligence to the proof read-

er's illusion with 43 students. The group was divided into two sections on the basis of the pooled results from five intelligence tests. This division was said to correlate with class room ability. The two sections were compared as to their ability to note errors in copy. Members of the more intelligent section were the quickest to detect and correct such errors.

Burtt's papers (**1, 2**) concern the illusory perception of motion induced by the successive presentation of two spatially discrete stimuli. In the first auditory stimuli were employed and the illusion was obtained under certain conditions. Individuals differ in their susceptibility. Suggestion is an effective factor. In studying the relation of the duration of the sounds to the length of the intervening period, it was found that an increase in the duration of exposure necessitated a decrease in the interval to secure the maximum of illusory effect. The direction of the illusion may be reversed by making the second of the two sounds the more intense. Tactual stimuli were employed in the second experiment. The mutual relations between the distance and time interval separating the stimuli and their intensity and duration were studied. It was found that an increase in the distance between the two stimuli necessitates a correlative increase in the time interval or in the intensity of the stimuli in order to preserve the illusion. Likewise as the intensity or duration of the stimuli are increased, the interval must be decreased. The direction of the illusory movement can be reversed by making the second stimulus the more intense. The results harmonize with those of similar experiments in the field of vision. The similarity of the results for three different senses suggests an explanation in central terms. Wertheimer's hypothesis is discarded as inapplicable to the field of hearing. An explanation in terms of the action theory is suggested.

Ritter (**5**) studied the V-H illusion when the point of juncture of the two lines was fixated throughout a long exposure. She used the method of gradual adjustment performed by the experimenter at the dictation of the observer. Besides the usual vertical horizontal relations, comparisons were instituted between lines situated on eight meridians when their angular relation was varied. It was found that illusory disparities existed for any two meridians and that all were similarly affected by the variable conditions studied. It was thus concluded that the vertical horizontal illusion is but a special case of meridional disparities, all of which must be explained in the same manner. The character of these disparities varies with

the individual. Practice increases the illusions with some individuals and decreases them with others. The adjustment of the variable line operates to increase the apparent length of the standard line when placed in the opposite half of the visual field. The following factors were ineffective: astigmatism, ocular balance, head position, ocular position, bodily position, objective contour, and inequalities of illumination in different portions of the visual field. Attention to either line with constant fixation diminished its apparent magnitude. The relation of the illusion to the length of the lines was studied. By intercepting vision of the two lines for a certain distance from their point of juncture, judgments were obtained of the illusory disparity of two lines when peripherally perceived. By combining the results of these two tests, it was possible to estimate the relative influence of the foveal and peripheral portions of the retina in contributing to the illusion. It was found that the peripheral portions were the more effective, and that the foveal segment may tend to reverse the illusion. It is concluded that the illusions are due to attention which is conditioned in part by retinal factors and in part by eye movements.

REFERENCES

1. BURTT, H. E. Auditory Illusions of Movement—A Preliminary Study. *J. of Exp. Psychol.*, 1917, 2, 63–75.
2. BURTT, H. E. Tactual Illusions of Movement. *J. of Exp. Psychol.*, 1917, 2, 371–385.
3. DOWNEY, J. E. The Proof-reader's Illusion and General Intelligence. *J. of Phil., Psychol., &c.*, 1918, 15, 44–47.
4. PETERSON, J. Some Striking Illusions of Movement of a single Light on Mountains. *Amer. J. of Psychol.*, 1917, 28, 476–485.
5. RITTER, S. M. The Vertical-Horizontal Illusion. An Experimental Study of Meridional Disparities in the Visual Field. *Psychol. Monog.*, 1916, 23, No. 101. Pp. 110.

GRAPHIC FUNCTIONS

BY JUNE E. DOWNEY

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Since the last review on this topic little has appeared that is new. Surveys of writing proficiency by means of the current scales are reported from time to time and are of service in standardizing handwriting requirements and in refining procedural technique. Ashbaugh (1) reports on the attainment in handwriting of Iowa school children; and Breed and Down (4) report for Grades III to

VI of the Highland Park, Michigan, schools. Breed and Down urge that each school should establish norms of achievement and should construct its own scale for measuring achievement.

Breed and Culp (3), continuing their investigation of the relation of legibility and form in handwriting, find that, of the five factors considered, letter-formation is most closely related to legibility; spacing is next; and uniformity of alignment, quality of line and uniformity of slant follow in the order mentioned. Legibility was determined by the speed-of-reading method and the factors for form were found measurable by Freeman's scale. Graves (12) reports on the relation of slant, spacing, arrangement, letter-size, and form of movement to legibility and to speed. Convenient schemes for tabulating data are presented. Some of the results of this investigation are rather unexpected; the high speed and legibility of back-slant, for example. This outcome must, however, be reviewed in light of the very small percentage of backhand writers in Graves' original group and the large deviation from the medium in the case of this subgroup. Interesting facts with reference to graphic instability are also brought out by Graves' tabulation. Manuel (13) in an interesting article suggests that the deterioration of forms in adult writing should be analyzed as a means of determining what modifications should be introduced into teaching practise, in the hope of rendering writing habits more permanent. "We could guard against the deterioration or else change the forms which we try to teach, making them from the first like they tend to become."

The report of cases of mirror-writing in ophthalmological journals suggests a point of departure not taken very seriously today, the reference, that is, of spontaneous mirror-writing to visual defect of some sort. Calhoun (7) states the present day attitude, gives a brief summary of the literature of the subject, and reports for the case he had under investigation that the child's vision was normal except for a small amount of hyperopia, that he showed some tentendency toward the use of the left hand and was awkward with the right. Brown's report (5) on a colored boy emphasizes the pedagogical aspect of the case. Three years were needed to overcome the practise of mirror-writing. The "patient" has always written with his right hand although he has some of the habits of the left-handed child; vision is normal. Brown gives interesting reproductions of cipher characters and of script as copied by the child from the blackboard. All other forms of displacement as well as the

conventional mirror-forms occur. The boy in question was thought to be a dullard until his peculiarity of expression was discovered; at ten years, his work is average.

Fuller (10) presents a most instructive series of experiments on mirror-writing designed to test the author's theory as to the principal cause for mirror-writing. The spontaneous unpracticed writing of the left hand is reversed writing because of symmetrical accompanying movements for the two halves of the body. The infrequency with which mirror-writing is produced with the left hand is due to visual supervision. If disorganization through distraction of attention can be experimentally induced mirror-writing should result, for "crossed impulses will be free to function." Fuller tested the effect of dissociation in hypnosis, hysteria, drug-intoxication and found reversed writing a frequent occurrence but he was not successful in his attempt to induce mirror-writing by the use of a prism which reversed the visual field. Sudden spontaneous complete reversals are held to result from "organic or functional lesions having the nature of a dissociation." But besides automatic unpracticed mirror-writing two other forms of mirror-writing occur: (1) Deliberate controlled mirror-writing; and (2) Fragmentary reversals growing out of the confusion of lateral space-relationships and frequently appearing in the normal right-handed writing of children at a certain stage in development and in the writing of the unlettered.

An experiment on "Handwriting Disguise" is reported by Downey (8). The investigation sought to determine the graphic elements which were most frequently changed in intentional disguise and by this means to discover the specific effect upon handwriting of an unusually high degree of control. Striking individual differences in capacity to mask the hand were evident. Probably age and sex were slightly influential in determining ease or difficulty in disguise. Downey and Anderson (9) report considerable retention of power to write and read simultaneously after a cessation of practice for more than two years but with curious differences in the reactions of the two subjects.

The most significant production on the psychology of drawing in the period under consideration is that of Ayer (2). Ayer presents a most excellent survey of the existing literature on the psychology of drawing, a survey which is made to contribute to Ayer's chief purpose the study of drawing as a device in laboratory teaching. As one outcome of his experiments Ayer recommends the substi-

tution in laboratory teaching of description, memory drawing, and analytical drawing for representative drawing.

Some interesting reproductions of the pictorial art of the insane are furnished by Burr (6), who concludes from his study that such art is very largely representative of emotional states and complexes, and is often subtly symbolic.

George (11) analyzes with care the statement that the Arabs use gestures in affirmation and negation that are just the reverse of those with which we are familiar. He concludes that such a belief originated in a superficial and unscientific observation and that the gestures in question are among the Arabs similar to our gestures in the west.

References

1. Ashbaugh, E. J. *Handwriting of Iowa School Children.* State Uni. Iowa, 1916, Extension Division Bull. No. 15.
2. Ayer, F. C. *The Psychology of Drawing with Special Reference to Laboratory Teaching.* Baltimore, Warwick & York, 1916. Pp. ix + 186.
3. Bread, F. S., & Culp, V. The Relation of Legibility and Form in Handwriting. *School & Soc.*, 1916, 4, 870–872.
4. Breed, F. S., & Down, E. F. Measuring and standardizing handwriting in a school system. *Elem. School J.*, 1917, 17, 470–484.
5. Brown, S. H. Mirror-Writing. *Ophthalmology*, 1916, 12, 437–445.
6. Burr, C. B. Art in the Insane. *Amer. J. of Insanity*, 1916, 73, 165–194.
7. Calhoun, F. P. The Report of a Case of Mirror-Writing. *Ophth. Rec.*, 1915, 24, 455–461.
8. Downey, J. E. Handwriting Disguise. *J. of Appl. Psychol.*, 1917, 1, 368-379.
9. Downey, J. E., & Anderson, J. E. Retention of Skill after Lapse of Practice; Simultaneous Reading and Writing. *Amer. J. of Psychol.*, 1917, 28, 396–408.
10. Fuller, J. K. The Psychology and Physiology of Mirror-Writing. *Univ. of Cal. Pub. in Psychol.*, 1916, 2, 199–265.
11. George, S. S. The Gesture of Affirmation among the Arabs. *Amer. J. of Psychol.*, 1916, 28, 320–324.
12. Graves, S. M. A Study in Handwriting. *J. of Educ. Psychol.*, 1916, 7, 483–494.
13. Manuel, H. T. Studies in Handwriting. *School & Soc.*, 1917, 5, 327–330.

NOTES AND NEWS

At Northwestern University Dr. Robert H. Gault has been promoted to the professorship of psychology.

The Federal Board for Vocational Education is publishing a monthly magazine, *The Vocational Summary*, which will contain articles and news on the vocational restoration of cripples as well as on the vocational training of normal individuals.

From the office of the Surgeon General of the Army there will be published a monthly magazine, *Carry On*, which is expected to circulate among those interested in the reëducation of disabled soldiers and sailors. The editor, Dr. Casey A. Wood, Major M.R.C., will be assisted by an editorial board and an advisory committee.

Professor G. M. Whipple has resigned his position at the University of Illinois and accepted a professorship of applied psychology at the Carnegie Institute of Technology. At the same institution Professor J. B. Miner has been promoted to an associate professorship, and Dr. L. L. Thurstone to an assistant professorship. Dr. Kate Gordon has been given leave of absence for the fall quarter. Dr. Beardsley Ruml has been granted leave for the whole year, and Professor Thurstone and Dr. T. J. Kirby half time leave to work on Army problems.

Professor R. M. Ogden, of Cornell University, delivered the commencement address at the University of Tennessee.

The following items have been taken from the press:

At Teachers College, Columbia University, leave of absence has been granted to Professor F. G. Bonser for the winter session of 1918–1919.

Professor Ewald Hering, the eminent physiologist, has died at the age of 84 years.

Dr. Buford J. Johnson has resigned her position as assistant psychologist in the laboratory of Social Hygiene, Bedford Hills, N. Y., and has accepted an appointment as research assistant in the Bureau of Educational Experiments, New York City.